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Analysis of high-latitude ionospheric processes during the November 3 2015 high-speed stream induced geomagnetic storm: A multi-instrument observational approach

High speed streams (HSS) originating from coronal holes led to significant increases in geomagnetic activity starting on Nov 3, 2015. The induced physical processes and impacts of HSS-driven geomagnetic storms differ in some aspects from storms originating in coronal mass ejections (CME). The solar wind (SW) velocity and interplanetary magnetic field (IMF) parameters showed typical HSS-like behavior. The magnitude of V_x increased gradually to approximately *800 km/s* starting in the early hours of Nov 3. Meanwhile B_z variations increased significantly, but B_z did not show similar changes that normally occur for CME impacts. One of the serious impacts of this particular event was on radio communications, during which Swedish air space was closed for approximately one hour due to major difficulties experienced by air traffic personnel.

We present the dominant high-latitude ionospheric physical processes during the storm and compare them with CME-originated storm effects. Using a multi-instrument observation approach we analyzed a set of observations including total electron content (TEC) and rate of TEC index (ROTI) data obtained from GNSS ground stations in Greenland, Iceland, and Scandinavia. In addition, we also used ground-based data of magnetic field variations, thermospheric columnar O/N_2 ratios derived from TIMED/GUVI and SuperDARN plasma convection and electric field maps. We show high-latitude top-side in-situ ion flux measurements from the Canadian e-POP instrument in addition to radio occultation profiles. Using the combined data sources we reconstructed the storm-induced geophysical mechanism. We also investigated and assessed storm influences on airborne navigation at high-latitudes in order to determine the possible cause of the radio communication disturbances. This effort may lead us to a better understanding of the phenomenon and might help develop communication hardware that is more resistant to such effects.